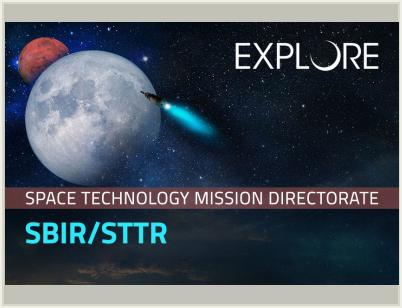
Propulsion Design with Freeform Fabrication, Phase I

Completed Technology Project (2009 - 2009)

Project Introduction

Propulsion Design with Freeform Fabrication (PDFF) will develop and implement a novel design methodology that leverages the rapidly evolving Solid Freeform Fabrication (SFF) manufacturing techniques and materials in the advancement of spacecraft propulsion components development and production. This effort will engender otherwise unproducible designs that significantly improve performance, thermal management, power density, and stability, while reducing thruster development and production costs. The key feature of the SFF technique is the capability to form objects with any geometric complexity without the need for elaborate machine setup or final assembly. The application of SFF to propulsion components requires an evolution of design practice to harmonize material properties with functional efficiency. Using the expertise of propulsion industry analysis, design and development engineers, a new class of design approach will be developed for the enhancement of performance, combustion stability, weight reduction, and increased operating envelope as applied to liquid rocket injectors. The Phase I effort will establish material requirements specifications for dimension resolution, structural and thermal properties, and propellant compatibility. The various SFF techniques will be assessed to identify strengths and weakness as applied to propulsion component development and production. Assembly, inspection, and quality control requirements will be assessed. Novel approaches to component sensing and control will be investigated for the feasibility of embedded instrumentation and MEMS during production. The application of fluidics for rocket injection logic will be investigated. As a technology demonstration for Phase I, a novel, high performance, lightweight injector design for a pulsing attitude class thruster will be developed based on the project's investigation using the latest high-temperature SFF materials.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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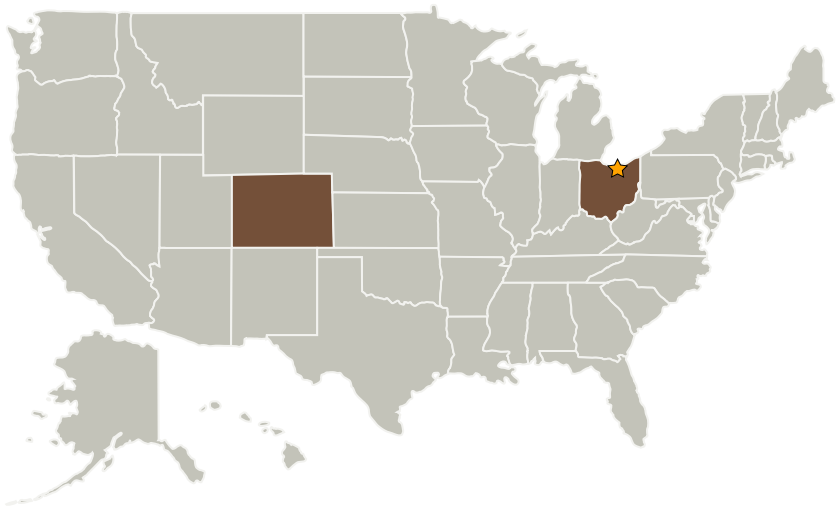
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
DMX Engineering	Supporting Organization	Industry	Durango, Colorado

Primary U.S. Work Locations	
Colorado	Ohio

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.4 Advanced Propulsion
    - TX01.4.4 Other Advanced Propulsion Approaches